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DESIGN, DEVELOPMENT AND DELIVERY OF ONE (1) BREADBOARD AND THREE (3) PRODUCTION UNITS OF A 75 VA INTEGRATED STATIC INVERTER

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SECTION II

TECHNICAL DISCUSSION

A. Progress Report for Month of March, 1966

1. Summary

Figures 1, 2, 3 and Table 1 (all located in the Appendix) are updated versions of the same figures and tables submitted in the "Detailed Subassembly Design Report" submitted last month. Any significant deviation from that Subassembly Design Report will be reported in an appendix to the monthly report as is being done this month.

Several minor circuit modifications were made to the breadboard to improve performance at the temperature extremes.

The variable duty cycle one-shots with gold lead pattern were slice probed, canned and tested electrically.

Construction has begun on the breadboard to be shipped to Huntsville.

System packaging details have been receiving consideration, particularly the potting of the inductors.

Operating $\div$ 10, $\div$ 12, and Ripple Counter arrays have been fabricated. The first lot of Johnson Counter material has been evaluated in slice form. Several arrays indicated proper operation; these arrays are being mounted in packages for further electrical and mechanical evaluation.

Sufficient material has been processed through the required diffusions to satisfy the total requirement of this program. This material is currently being probed and assembled.

Fabrication of the dual power devices has been delayed by the problem of cap ceramic fracture during cold weld. Alternative fabrication techniques are now being evaluated.

2. Progress Report on Subsections

a. Inverter Breadboard

In the Appendix is shown the block diagram (Figure 1) and the system schematic (Figure 2) as the inverter will be when it is completed. A difference exists between schematics Figure 1 of the text and Figure 2 of the Appendix only in the finalized components and packages. What we do have at present is shown in Figure 1.

The efficiency of this breadboard for 28 volts input and 100% rated load output is 65%.

Temperature tests have been run and have resulted in several modifications; primarily the addition of stabistors for temperature compensation.

(1) Variable Duty Cycle One-Shot

After testing the new gold lead pattern variable duty cycle one-shots (L-169's) at elevated temperature, it was decided not to use the internal diode between pins 1 and 2 (See Figure 3 of Appendix) since better performance could be obtained using a discrete diode.

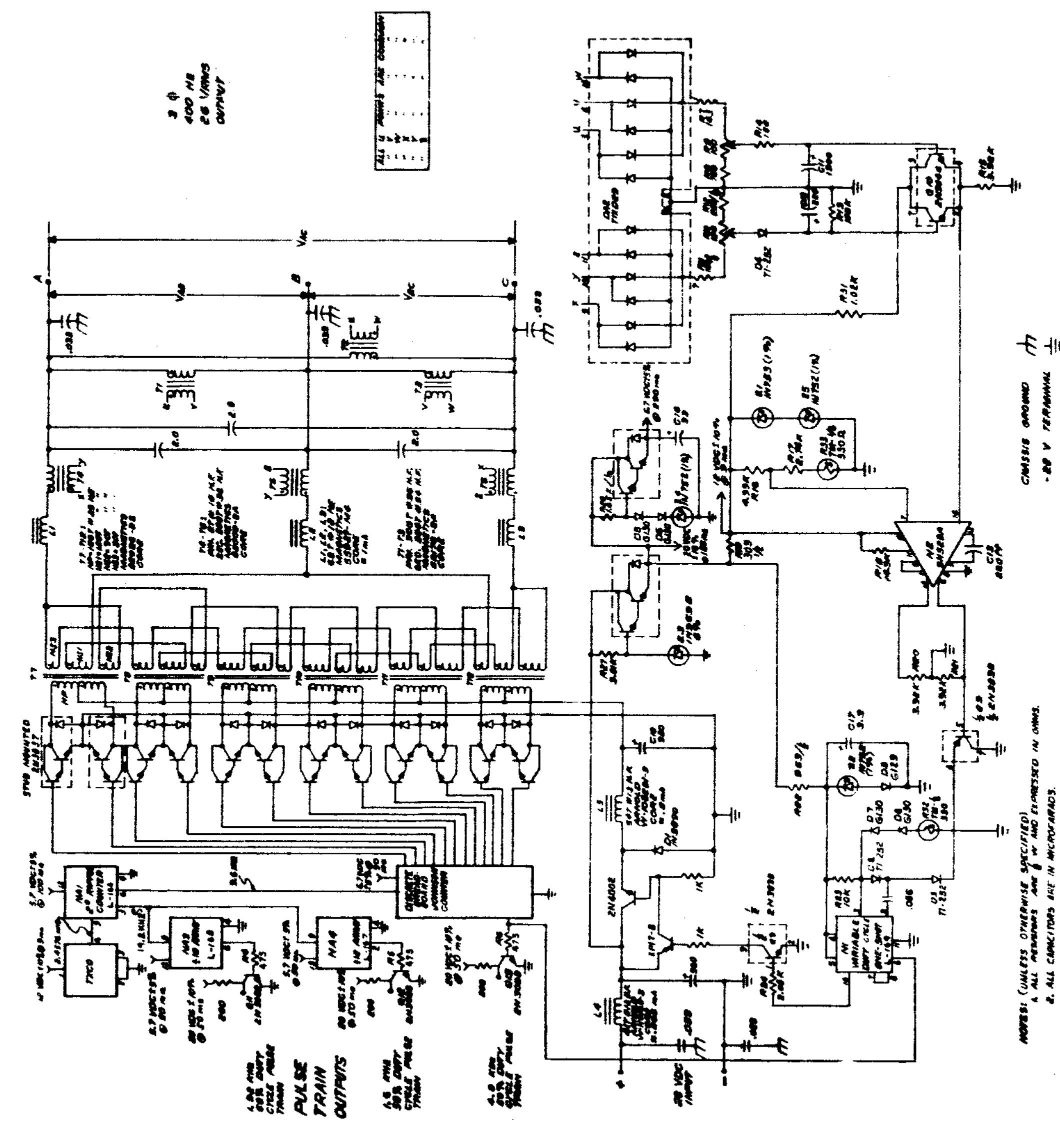

Figure 1. 75 VA Integrated Static Inverter — Revised April 1, 66

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(2) Potting Compound

A decision was made to use Emerson & Cumings Stycase 1090 with Catalyst 11 as the potting compound for the inductors and some capacitors (See Figure 2 of Appendix). A sample transformer, handling the power equivalent to 150% rated load for one transformer, had its internal temperature checked with a thermocouple buried in the primary winding. The potted transformer showed only a 10°C increase in internal temperature over the temperature of the unpotted transformer.

(3) Final Inverter Breadboard

Construction has begun on the breadboard to be shipped to Huntsville. An effort is being made to make the placement of the components in this breadboard very similar to the component placement visualized for the final packages. This should be a great help in bringing to light any difficulties which might occur later because of wiring, cross talk, etc.

b. Flip-Flop Arrays

The metallization and contact masks for the Johnson Counter were processed. The computer program used for the metallization pattern was most satisfactory. This is a significant accomplishment.

Silicon slices for both the Ripple Counter array types and the Johnson Counter arrays are in the final stages of diffusion processing. Packaged and tested units of all three of the Ripple Counter array types (÷ 10, ÷ 12, ÷ 256) have been fabricated. Additional units are being tested. The first lot of Johnson Counter arrays has been probed, and is being assembled prior to encapsulation and final test. Additional lots of material are being readied for slice probing.

Thermal resistance experiments on the 16-pin integrated circuit package have been completed. Data are presently being tabulated. This package, using alloying as the technique for mounting the silicon bar in the package, shows excellent heat transfer characteristics.

c. Power Transistors

A problem has been encountered in the cold weld sealing of the 11/16" hexagonal composite package for both the dual darlington (L-163) and the complementary NPN-PNP (L-164). A fracture occurs concentric with the flange in the cap ceramic during the cold weld operation.

Several approaches are being followed to eliminate this fault:

1) The cold weld punch is being modified to minimize inward flow of the displaced copper flange.
2) The cap structure is being modified to minimize ceramic stress.
3) The effect of variations in the cold weld ram speed and total load is being investigated.
4) An entirely different punch design is under consideration.

Device fabrication is continuing on the steps preceding the cold weld sealing. The devices will then be hermetically sealed after this problem has been solved.

B. Current Problems and Corrective Action

See section on Power Transistors.

C. Work to be Performed During Next Reporting Period

1. System

a. Continue testing system at temperature extremes to insure performance is satisfactory.

b. Continue testing newly packaged variable duty cycle one-shots.

c. Pot up inductors.

d. Finish building final breadboard and begin performance testing.

2. Flip-Flop Arrays

a. Categorize and deliver Johnson Counter arrays.

b. Finish processing of all array types.

3. Power Transistors

a. Correct the ceramic fracture problem; fabricate and test devices.

APPENDIX

Revisions to Detailed Subassembly Design for 75VA Integrated Static Inverter - Submitted initially 3-1-66.

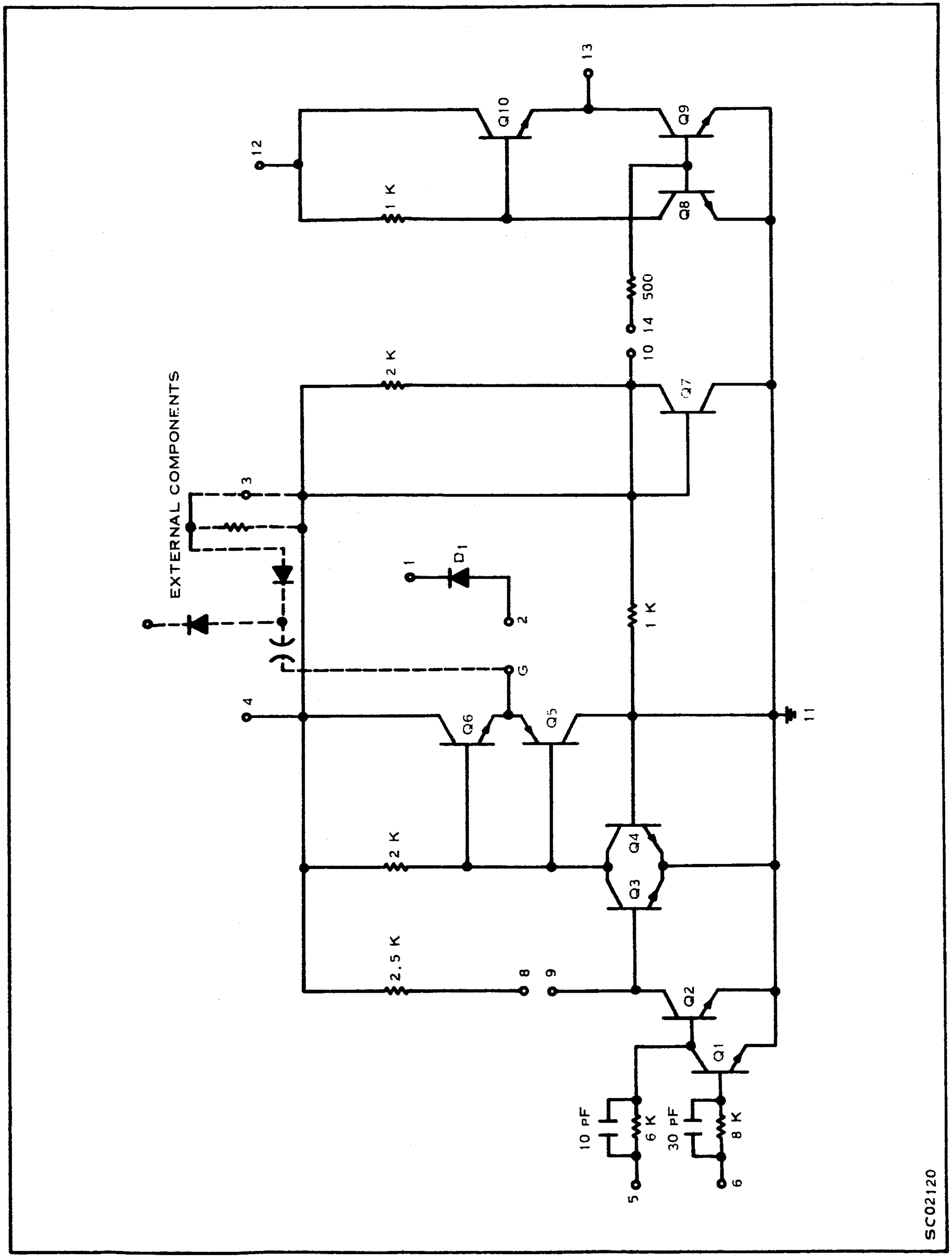

Figure A-1. Block Diagram — 75 VA Integrated Static Inverter, Revised 4-1-66

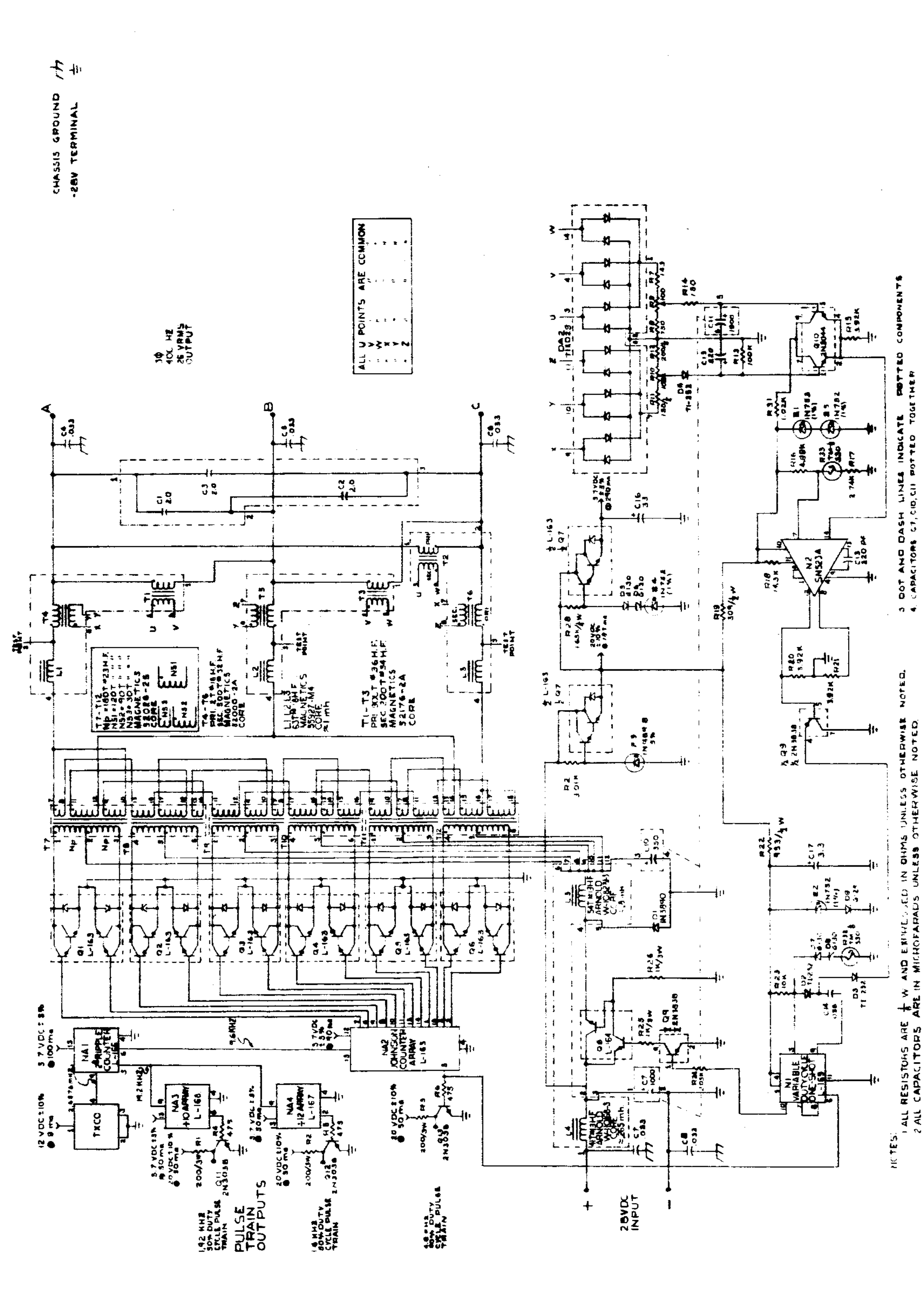

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Figure A-2. System Schematic — 75 VA Integrated Static Inverter, Revision No. 1, Dated April 1, 1966

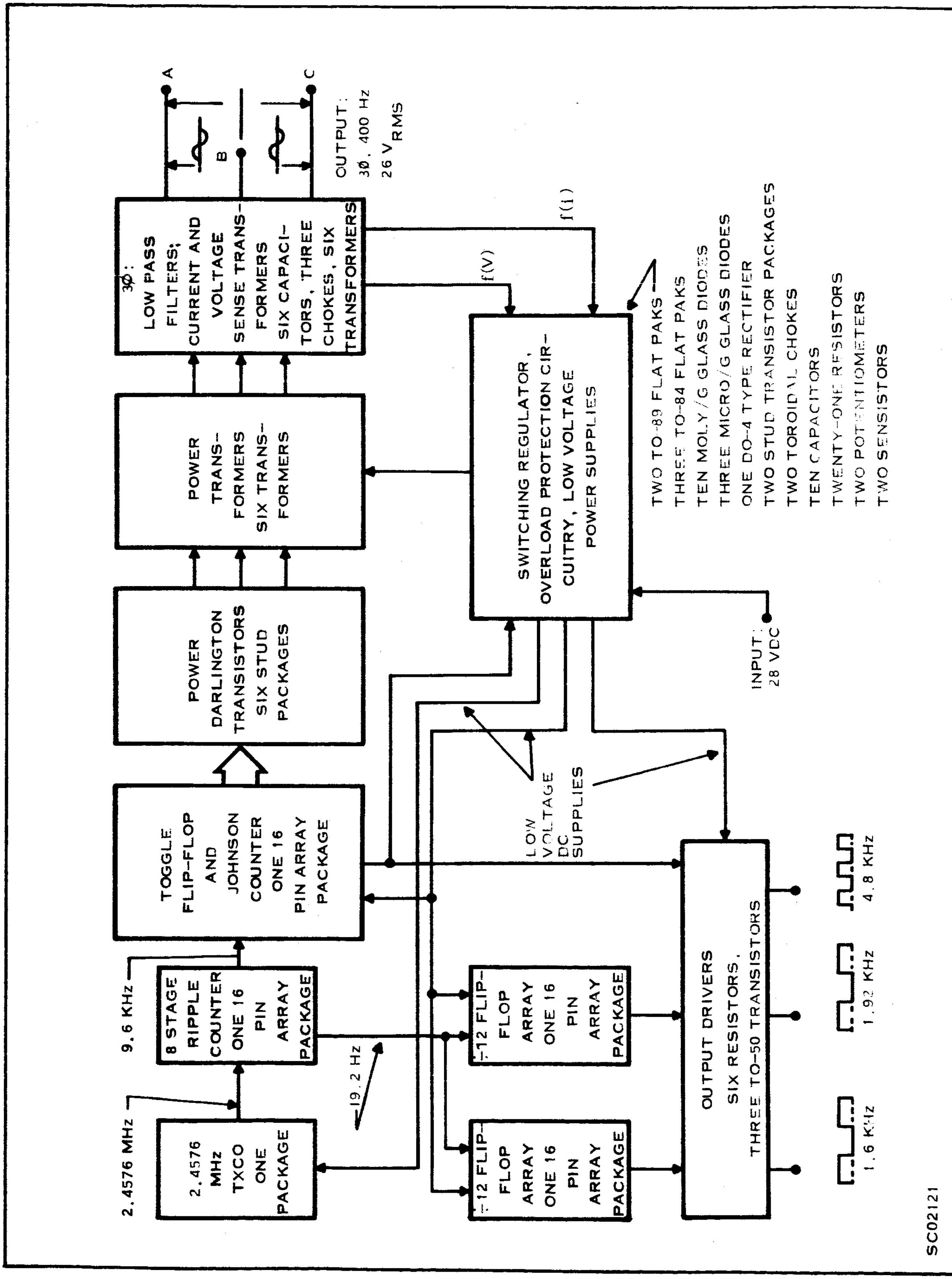

Figure A-3. Variable Duty Cycle One-shot, Revised 4-1-66

Table 1. Parts List - 75 VA Integrated Static Inverter

(Originally Issued March 1, 1966)

Component Designation	Description of Components	Manufacturer	Date of Change	Comments
Q1-Q7	L-163, Dual Power NPN Darlington Transistor, 6 Pin Stud Package	TI		Developmental Item
Q8	L-164, Dual Power NPN-PNP Transistor, 6 Pin Stud Package	TI		Developmental Item
Q9	2N3838, Dual PNP-NPN Transistors in TO-89 Package	TI		
Q10	2N3044, Dual NPN Transistors in TO-89 Package	TI		
Q11-Q13	2N3038, Transistor in TO-50 Type Package	TI		
N1	L-169, Integrated Circuit Variable Duty Cycle One-Shot; Mask Modification of SN5380	TI		Developmental Item
N2	SN523A, Integrated Circuit Differential Amplifier	TI		
NA1	L-166, Integrated Circuit 8 Stage Ripple Counter Array	TI		Developmental Item
NA2	L-165, Integrated Circuit 6 Stage Johnson Counter and Toggle Flip-Flop Array	TI		Developmental Item

Parts List - 75 VA Integrated Static Inverter

Table 1. (Continued)

Component Designation	Description of Components	Manufacturer	Date of Change	Comments
NA3	L-168, Integrated Circuit ÷10 Flip-Flop Array	TI		Developmental Item
NA4	L-167, Integrated Circuit ÷12 Flip-Flop Array	TI		Developmental Item
TXCO	2.4576 mc Temperature Compensated Crystal Oscillator	Bendix		Developmental Item; Weight ≈ .71 oz.
C1-C3	K1G205J-H1, 2uf, 100VDC, ± 5% Polycarbonate Capacitor	Elpac	4-1-66	
C4-C8	K1G333K-D2, .033uf, 100VDC, ±10% Polycarbonate Capacitor	Elpac		
C9	202D108X0050A5, 50VDC, 1000uf, ± 20%, Tantalum Capacitor	Sprague		
C10	202D357X9150A5, 150VDC, 350uf, ± 10%, Tantalum Capacitor	Sprague		Weight ≈ 5.5 oz.
C11	202D198X9015A2, 15VDC, 1900uf, ±10%, Tantalum Capacitor	Sprague		Weight ≈ 3.0 oz.
C13	SCH06F221M, 220pf, 100VDC, ±20% Ceramic Capacitor	Scionics		
C12	Deleted		4-1-66	

Parts List - 75 VA Integrated Static Inverter

Table 1. (Continued)

Component Designation	Description of Components	Manufacturer	Date of Change Notice	Comments
C14	K1G563F-G1, .056uf, 100VDC, ±1%, Polycarbonate Capacitor	Elpac		
C15	SCM227HP010D2, 220 uf,10VDC, ±10% Tantalum Capacitor	TI		
C16	SCM336BP010D4, 33uf,10VDC, ±20% Tantalum Capacitor	TI		
C17	SCM335FP010D4, 3.3uf,10VDC, ±20% Tantalum Capacitor	TI		
Z1	1% 1N753, 6.2V, Breakdown Diode, Moly/G Glass Package	TI	4-1-66	Selected from 1N759 family
Z2, Z4, Z5	1% 1N752, 5.6V, Breakdown Diode, Moly/G Glass Package	TI	4-1-66	Selected from 1N752 family
Z3	1N969B, 22V, 5% Breakdown Diode Moly/G Glass Package	TI		
D1	1N3890, 100V, 12 AMP Fast Recovery Rectifier, DO-4 Type Package	TI		
D2, D3 D4	TI-252, 50V, 40ma Diffused Silicon Mesa Diode, Micro/G Package	TI	4-1-66	

Parts List - 75 VA Integrated Static Inverter

Table 1. (Continued)

Component Designation	Description of Components	Manufacturer	Date of Change	Comments
D5, D6 D7, D8	G130 Stabistor, Silicon Forward Conductance Diode, Moly/G Glass Package	TI	4-1-66	
D9	G129 Stabistor, Silicon Forward Conductance Diode, Moly/G Glass Package	TI	4-1-66	
DA1	Deleted		4-1-66	
DA2	TIXD29, 30V, Dual 10 Array, TO-84 Type Package	TI		
R1 - R3	RW69V201, 200Ω, 3W, Wirewound Resistor	Sprague		
R4-R6	CR-1/8, 475Ω, 1/8W, 1%, Carbon Film Resistor	TI	4-1-66	
R7	CR-1/8, 143Ω, 1/8W, 1%, Carbon Film Resistor	TI	4-1-66	
R8	CR-1/8, 750Ω, 1/8W, 1%, Carbon Film Resistor	TI		
R9, R10	3260H-1-101, 100Ω, Trimpot	Bourns		

Parts List - 75 VA Integrated Static Inverter

Table 1. (Continued)

Component Designation	Description of Components	Manufacturer	Date of Change	Comments
R11	CR-1/4, 150Ω, 1/4W, 1%, Carbon Film Resistor	TI		
R12	CR-1/4, 200Ω, 1/4W, 1%, Carbon Film Resistor	TI		
R13	CR-1/8, 100K, 1/8W, 1%, Carbon Film Resistor	TI		
R14	CR-1/8, 150Ω, 1/8W, 1%, Carbon Film Resistor	TI		
R15, R20, R21	CR-1/8, 3.92K, 1/8W, 1%, Carbon Film Resistor	TI		
R16	CR-1/8, 4.99K, 1/8W, 1%, Carbon Film Resistor	TI		
R17	CR-1/8, 2.74K, 1/8W, 1%, Carbon Film Resistor	TI	4-1-66	
R18	CR-1/8, 14.3K, 1/8W, 1%, Carbon Film Resistor	TI		
R19	MC65 T-O, 309Ω, 1/2W, 1%, Metal Film Resistor	TI	4-1-66	

Parts List - 75 VA Integrated Static Inverter

Table 1. (Continued)

Component Designation	Description of Components	Manufacturer	Date of Change	Comments
R22	MC65 T-O, 953Ω, 1/2W, 1%, Metal Film Resistor	TI		
R23	CR-1/8, 10K, 1/8W, 1%, Carbon Film Resistor	TI		
R24	CR-1/8, 2.05K, 1/8W, 1%, Carbon Film Resistor	TI		
R25, R26	RW69V102, 1K, 3W, Wirewound Resistor	Sprague		
R27	CR-1/8, 3.01K, 1/8W, 1%, Carbon Film Resistor	TI		
R28	CR-1/4, 1.65K, 1/4W, 1%, Carbon Film Resistor	TI		
R29	Deleted		4-1-66	
R30	Deleted		4-1-66	
R31	CR-1/8, 1.02K, 1/8W, 1%, Carbon Film Resistor	TI	4-1-66	
R32, R33	330Ω, ±5%, TM1/8, Sensistor	TI	4-1-66	

Parts List - 75 VA Integrated Static Inverter

Table 1. (Continued)

Component Designation	Description of Components	Manufacturer	Date of Change	Comments
L1-L3	AC Choke, ≈ 1mh, 63 Turns, #18 H.F. Core: Magnetics 55927-M4 Powdered Iron Toroid	-		Unpotted Weight of Each Choke ≈ 2.0 oz.
L4	DC Choke, ≈ .265mh, 41 Turns, #13 H.F. Core: Arnold W110168-3 Powdered Iron Toroid	-	4-1-66	Unpotted Weight of Choke ≈ 5.5 oz.
L5	DC Choke, ≈ .8mh, 54 Turns, #13 H.F. Core: Arnold W-108281-3 Powdered Iron Toroid	-	4-1-66	Unpotted Weight of Choke ≈ 10.6 oz.
T1-T3	Voltage Sense Transformers, Cores: Magnetics 52176-2A, Tape Wound Toroids, PR1. 900T #36 H.F., SEC. 200T #34 H.F.	-		Unpotted Weight of Each Transformer ≈ .47 oz.
T4-T6	Current Sense Transformers, Cores: Magnetics 52000-2A Tape Wound Toroids, PR1. 2T #16 H.F., SEC. 500T #32 H.F.	-		Unpotted Weight of Each Transformer ≈ .44 oz.
T7-T12	Power Transformers, Cores: Magnetics 52026-2S Tape Wound Toroids, PR1. 180T, SEC. NS1 = 120T, NS2 = 90T, NS3 = 30T. All Wire is #23 H.F.	-		Unpotted Weight of Each Transformer ≈ 4.3 oz.
X1	#663 Thermistor	FEIC		Not shown or discussed elsewhere in this report.